REMARKS

Independent claims 33 and 63 have been amended to clarify that the invention includes a single flexible flap that has only one free portion.

Claims 33-71 of this application have been noted as conflicting with claims in other pending applications that applicants have before the United States Patent and Trademark Office. Applicants respectfully submit that the claims that are pending in this application do not conflict with any of the claims that are present in those applications. To the extent that there is a conflict, however, applicants will either cancel those claims or file a Terminal Disclaimer to overcome any double patenting rejection that may exist in this case when it is otherwise in condition for allowance.

Claims 33-56 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over U.K. Patent Application GB 2,072,516A to Simpson in view of U.S. Patent 3,191,618 to McKim. Applicants respectfully submit that this rejection cannot be sustained.

In making this obviousness rejection, the Examiner correctly indicates that Simpson does not describe a flexible flap that is secured to the valve seat at two securement points. There is, however, another notable difference between applicants' claimed invention and the Simpson disclosure. Applicants' invention also requires that the "flexible flap be positioned on the valve seat such that the flap is pressed towards the seal surface in an abutting relationship therewith when a fluid is not passing through the orifice."

Simpson shows two different valves, neither of which shows these features of applications' invention:

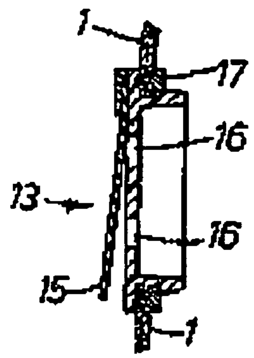

FIG. 2.

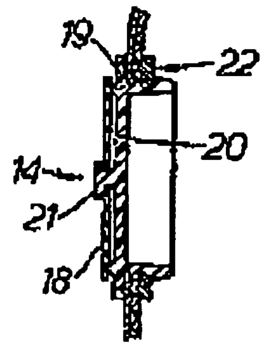

FIG. 3.

In neither of these embodiments is the flexible flap 15 or 18 mounted to the valve seat such that the flap that is pressed towards the seal surface in an abutting relationship with it under neutral conditions. A person skilled in the field of respirators and respirator components, David M. Castiglione, in his February 2, 2001 Affidavit, has provided evidence that establishes that the valve 13 shown in Figure 2 of Simpson does not have its flap *positioned on the valve seat* such that the flap 15 is *pressed* towards the seal surface in an abutting relationship with it when a wearer is neither inhaling nor exhaling. Castiglione states that "there is nothing that can be discerned from Figure 2 or from the specification that would indicate that the flap is pressed towards the seal surface in its neutral position." Castiglione explains that the mounting of the Simpson flap at the top or fixed portion would cause no force or preload to be exerted upon the flap. Such a force is needed to bias the flap or otherwise cause it to be pressed against the seal surface. As the above-reproduced FIG. 2 illustrates, the flap 15 on valve 13 would at best be in mere contact with the seal surface when a wearer is neither inhaling nor exhaling. Such a structure cannot provide the benefits that applicants' invention provides, namely, the ability to keep the valve hermetically sealed under any orientation of the valve.

Simpson's valve provides protection to the wearer only at the most critical time — during an inhalation. When a wearer of the Simpson mask inhales, the flap becomes firmly pressed against the seal surface by virtue of the negative pressure inside the mask. But when the wearer is neither inhaling nor exhaling, and has their head tilted downward, the possibility exists that contaminants can enter the mask interior when the flap droops downwardly away from the seal surface. Unlike Simpson, applicants teach persons of ordinary skill how to make a low pressure drop, flapper-style

exhalation valve that will preclude contaminant influx under all orientations of the mask. The failure to appreciate the advantages that applicants' invention provides, further established its nonobviousness.[1] In short, Simpson does not teach the positioning of the flap to allow it to be pressed against the seal surface of applicants' valve, and it does not appreciate the benefits that can stem from this aspect of applicants' invention.

In addition, Simpson does not indicate that the flap 18 in Figure 3 is pressed against the seal surface. Unlike the Figure 2 flap 15, the Figure 3 flap 18 is shown to be flush against the seal surface, but there is nothing to indicate that the flap is pressed against that surface. If such were the case, you would expect Simpson to show the flap 18 as being in an at least slightly curved configuration. A planar flap would not be pressed against the seal surface unless it was already prestressed or curved in a concave configuration. Simpson's flap resides in a perfectly linear configuration when at rest, and there is nothing in the text that otherwise suggests that it is prestressed. Thus, Simpson's button-style valve 14, even though not nearly as pertinent to applicants' invention as its flapper valve 13, also is not pressed towards the seal surface.[2]

In the Office Action mailed January 2, 2002, the Examiner indicates that "Simpson et al. as modified by McKim as discussed above with respect to claim 33, also teach the flexible flap being positioned on the valve seat such that the flap is pressed towards the seal surface in abutting relationship therewith when a fluid is not passing through the orifice". Applicants dispute this interpretation of the McKim patent. Firstly, McKim does not teach or suggest a flexible flap. McKim discloses a reed valve for a 2-cycle engine. There is nothing in the McKim disclosure, which indicates that the reed valve would be "flexible" as that term is defined in the present application. Applicants define the term "flexible" to mean that "the flap can deform or bend in the form of a self-supporting arc when secured at one end as a cantilever and viewed from a side elevation (see e.g., Fig. 5)."

[1] *In re Fine*, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988).

[2] Simpson's Figure 3 valve 14 is a button-style valve that is centrally mounted at a hub 21. Button-style valves do not have a peripheral edge that includes a stationary segment and a free segment. Nor do they have opposing stationary and free ends. In button-style valves, the whole peripheral edge is free to be lifted from the seal surface (Simpson, lines 58-61). These valves are disadvantageous in that the central mounting does not provide the large moment arm that flapper-style valves can provide. The limitations recited in applicants' independent claims under (b) (2) (iii) describe a flapper-style system and not a button-style system.

As indicated in the attached Declaration of Richard Betts, a person skilled in the art of two-cycle engines, the McKim reed valve is not "flexible" as the term is defined in the present application:

> 5. Since 1965, the 2-cycle engines that I have either constructed or worked on have used a reed valve of varying degrees of stiffness. None of the reed valves that I have encountered, however, were "flexible" as the term has been defined in the above-captioned patent application and recited in paragraph 4 above. Reed valves that are used on 2-cycle engines can bend when exposed to a force such as shown in Fig. 3 of the McKim patent. The reed valves, however, are not so flexible that they will bend in the form of a self-supporting arc when secured at one end as a cantilever. Reed valves do not bend in the form of such an arc in response to the mere force of gravity. If the valves were constructed to have that degree of flexibility, the 2-cycle engines in which they were used would surely not be operative. If secured at one end as a cantilever and having a free end that projects from the point of securement, a reed valve would project in an essentially straight line when viewed from a side elevation. The degree of stiffness that reed valves possess are orders of magnitude greater than the flexible flaps that are used on exhalation valves.

Simpson also does not disclose a flexible flap that is secured to the valve seat at the stationary portion of the flap at two securement points. Although the Examiner appears to recognize this fact, McKim is improperly relied on as a secondary reference for meeting this limitation.

The record does not present any evidence that the disclosures in Simpson and McKim are combinable. As the Examine is aware, there must be some teaching or suggestion or knowledge generally available that would have led a person of ordinary skill to combine the pertinent disclosures in two separate documents.[3]

A probable reason why the record lacks any evidence that the McKim teachings are combinable with Simpson is because McKim is directed to a field entirely different from the field of exhalation valves for respirators.

McKim describes a curved seat reed valve that is designed for use in a two-cycle, high-speed engine which would turn at extremely high rpms — that is, at speeds as high as 10,000 or

[3] *In re Fine* at 1599 ("Obviousness is tested by 'what the combined teachings of the references would have suggested to those of ordinary skill in the art.' But it 'cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching or suggestion supporting the combination.' And 'teachings of references can be combined *only* if there is some suggestion or incentive to do so.' Here, the prior art contains none."(citation omitted)).

12,000 revolutions per minute. This kind of technology would not be used by a person of ordinary skill in designing an exhalation valve for a respirator. McKim's valve is particularly suited for rapid operation where opening and closing forces are large. These forces can cause the valve to bounce (an elastic recoil from impact). The stated goals in McKim are full rapid-opening, quick and complete closing, and eliminating float or bounce. McKim's valve operates when a piston in the engine's cylinder moves from a top dead center to a bottom dead center, and the pressure within the crank case is reduced below atmospheric to overcome the spring bias of the valve reed. Castiglione explained why persons of ordinary skill in his field do not consult reed valves for high-speed engines when developing exhalation valves for face masks:

> A filtering face mask is worn over the nose and mouth of a person for filtering contaminants that may be present in ambient air. Filtering face masks commonly employ exhalation valves to allow more moist exhaled air to be rapidly purged from the mask interior. The exhalation valves are used to improve wearer comfort. These valves operate at normal room temperatures and low pressures. The field of endeavor for a filtering face mask is very different from the field of endeavor of a curved seat reed valve that is used in a high-speed engine. Persons of ordinary skill in the field of designing filtering face masks do not consult documents that describe valves for gasoline engines in developing respiratory products. Exhalation valves for respirators operate under very different conditions from valves that are used in gasoline engines and require extraordinarily different design parameters.
>
> [I]n exhalation valves for filtering face masks, the speed of opening is not a primary design parameter. There is no incumbent need to rapidly fill or exhaust a combustion chamber. Further, at the airflows and pressure drops that are encountered in a respiratory mask, "bounce" is not an occurring event. Investigators in the exhalation valve art for filtering face masks seek to produce exhaust valves that minimize force to open from the normally closed position. This particular design parameter is not compatible with fast-closing valves that require high forces for rapidly opening and closing. The flow volumes and flap stiffnesses are orders of magnitude higher for valves used in combustion engines as opposed to valves that are used on respiratory masks. For these reasons, a person of ordinary skill in the filtering face mask art would not have found the McKim patent to be reasonably pertinent to the problems that are encountered in the development of an exhalation valve for a filtering face mask.[4]

Also attached to this Amendment is a copy of Declaration signed by John Bowers, an inventor of an exhalation valve for Racal Health & Safety Limited (see U.S. Patent 5,687,767).

[4] Castiglione Affidavit signed November 15, 1999 (copy of Affidavit is attached).

Bowers states in paragraph 14 of his Declaration that McKim's goals of rapid opening, quick and complete closing, eliminating float or bounce have no pertinence to the operation of an exhalation valve where the opening and closing forces and speed with which the valve operates are on orders of magnitude different from the valve that is used in a two-stroke high-speed engine:

> 14. In exhalation valves for filtering face masks, the speeds for opening and closing is not a primary design parameter. There is no incumbent need to rapidly fill or exhaust a combustion chamber. Further, under the airflows and pressure drops that are encountered in a filtering face mask, "bounce or float" is not an occurring event or a problem that investigators in the exhalation valve art need to deal with. Investigators who design exhalation valves for filtering face masks seek to produce exhaust valves that remain closed between breaths and that minimize the force or pressure needed to open the valve from its normally closed position. This particular design goal is not compatible with or comparable to fast-closing valves that require high forces for rapidly opening and closing. Exhalation valves tend to open and close at the rate of a person's breathing, which is about 20 to 60 cycles per minute. In contrast, the McKim valve is designed to operate at speeds as high as 10,000 to 12,000 revolutions per minute. The flow volumes and flap stiffness are orders of magnitude higher for valves that are used in combustion engines as opposed to valves that are used on respiratory masks. For these reasons, a person of ordinary skill in the filtering face mask art would not, in my view, have found the McKim patent to be reasonably pertinent to the problems that are encountered in the development of an exhalation valve for a filtering face mask. McKim would not be a reference that would have logically commended itself to the attention of persons of ordinary skill in developing new exhalation valves for filtering face masks. I have not, nor have I witnessed, anyone who is skilled in the field of developing filtering face masks, look at the art of valves for two-cycle engines for solutions to problems confronted by them in the exhalation valve art.

This position is further supported by the Affidavit of Frank J. Fabin, a person who has been working in the field of occupational health for a number of years:

> 9. In my approximately 24 years of working in occupational health, I have not — nor am I aware of another person who works in this field who has — consulted a reference in the reed valve art for gasoline engines to obtain solutions to problems encountered in developing exhalation valves that are used on filtering face masks.

In view of this testimony, it is clear that persons of ordinary skill in the exhalation valve art would not have consulted a reference to a reed valve for a two-cycle engine in developing an exhalation valve for a filtering face mask. McKim is not a reference that would have logically commended itself to the attention of a person skilled in designing valves for filtering face masks. There is

nothing in the record that indicates otherwise. Thus, McKim cannot be properly used as a reference against the present invention, whether combined with the Simpson patent or not.

Like McKim, French Patent 1,209,475 also has been cited as a secondary reference that is allegedly combinable with Simpson. This patent has been relied on to teach the subject matter of claim 58. Applicants have obtained a translation of the French patent (copy furnished to the Examiner). It is clearly apparent that the subject matter described in the French patent does not relate in any way to the field of filtering face masks. The French patent describes a high-pressure valve that would be used in a conduit through which liquid flows. This field is wholly separate from exhalation valves for filtering face masks. In any case, the French patent does not disclose a valve cover — much less a valve cover suitable for use on an exhalation valve of a filtering face mask. The record also does present any evidence that shows why a person of ordinary skill in the field of filtering face masks or exhalation valves would have looked to the art of high-pressure valves that are used in liquid-containing conduits when designing a new exhalation valve for a filtering face mask. Without such evidence, the teachings of the French patent cannot be combined with those of Simpson.

Respectfully submitted,

April 2, 2002
Date

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

33. (amended) A filtering face mask that comprises:

(a) a mask body that is adapted to fit over the nose and mouth of a wearer; and

(b) an exhalation valve that is attached to the mask body, the exhalation valve comprising:

(1) a valve seat that comprises:

(i) a seal surface;

(ii) an orifice that is circumscribed by the seal surface; and

(iii) cross members that extend across the orifice to create a plurality of openings within the orifice; and

(2) a single flexible flap that has [a] only one fixed portion and [a] only one free portion and first and second opposing ends, the first end of the single flexible flap being associated with the fixed portion of the flap so as to remain at rest during an exhalation, and the second end being associated with the free portion of the flexible flap so as to be lifted away from the seal surface during an exhalation, the second end also being located below the first end when the filtering face mask is worn on a person, the flexible flap being positioned on the valve seat such that the flap is pressed towards the seal surface in an abutting relationship therewith when a fluid is not passing through the orifice, the flexible flap being secured to the valve seat at the fixed portion of the flap at two securement points, the two securement points being disposed outside a region encompassed by the valve seat orifice.

63. (amended) A filtering face mask that comprises:

(a) a mask body that is adapted to fit over the nose and mouth of a wearer; and

(b) an exhalation valve that is attached to the mask body, the exhalation valve comprising:

(1) a valve seat that comprises:

(i) a seal surface;

(ii) an orifice that is surrounded by the seal surface; and

(2) a single flexiblo flap that has [a] only one stationary portion and [a] only one free portion and a peripheral edge that includes a stationary segment and a free segment, the stationary segment of the single flexible flap's peripheral edge being associated with the stationary portion of the flap so as to remain at rest during an exhalation, and the free segment of the peripheral edge being associated with the free portion of the flexible flap so as to be lifted away from the seal surface during an exhalation, the free portion also being located below the stationary portion when the filtering face mask is worn on a person, the flexible flap being positioned on the valve seat such that the flap is pressed towards the seal surface in an abutting relationship therewith when a fluid is not passing through the orifice, the flexible flap also being secured to the valve seat at the stationary portion of the flap at two securement points.

French Republic
Ministry of Industry
Service of industrial property
Company: VEREINIGTE ARMATUREN-GESELSCHAFT M.B H Germany
Patent number 1 209 475

Application date August 8 1958 Paris
Allowed : September 21 1959 and published Marsh 2 1960

Valve with a sleeve like membrane for high pressure loads

Summary

The invention consists of a valve in the shape of a sleeve for high pressure loads in which exists an annular canal situated between the valve box and an internal lining body having an aerodynamic shape which is mounted concentrically in the box. This valve is closed by a sleeve like membrane that is anchored by one or both ends in the box and supported by an axial neck of the box. The membrane consists in its peripheral zone that varies during opening and closing of alternating interior and exterior grooves extending longitudinally to give a remarkable bellow effect by the following effects either individually or in cooperation:

a- The membrane consists near each neck of the box of a thickening in the shape of an annular bead with a first non sloped zone that closes the annular opening situated between the neck and the internal body of the lining like a stopper in the presence of high pressures acting on the external face of the membrane with simultaneous discharge in the peripheral direction.
b- The external wall of the membrane is bulged near the thickening so that a curvature exits on the external face of the membrane in an axial cross section in the presence of a high pressure load.
c- The thickening is made only on the external face of the membrane.

The present invention is about membrane valves for high pressure loads in which the annular canal between the valve box and the interior lining (approximately aerodynamic) mounted concentrically inside the box is closed by a sleeve like membrane.

Valves of this sort are fabricated both as check valves and inlet valves. Inlet valves of this type are generally made in such a manner that at rest the membrane is pushed against the interior wall of the box leaving open the annular canal between the box and the interior lining. The membrane is held at both ends in the box. To close the valve, One introduces a high pressure fluid in the chamber behind the membrane. This fluid presses the membrane inward towards the lining. In the case of check valves, the membrane is held only at one end in the box. It is held at rest by a small conical deformation in the annular space and maintained under low tension against the lining.

When a membrane of this kind is used as a stop valve for high pressure fluids, the wall thickness should be such it can resist the pressure. It is known that one constructs grooves in the membrane disposed alternately and laying longitudinally to obtain a bellow effect.

We noticed that when valves of this kind are loaded by an external high pressure, that is distribution pressure for closing the membrane in the case of inlet valves and return pressure for check valves, and when the interior of the membrane is subject only to small pressures or no pressure at all, the membrane is driven into the annular opening between the neck of the box and the interior lining. We also noticed that there is a danger of the membrane being driven too far through the annular opening and risk destruction. Even in the absence of sloping, there is a risk of destruction of the membrane when the grooves are extended to the shoulder or the neck of the box that holds it.

In the case of inlet valves of this kind, we also noticed a disturbing phenomenon in the presence of high pressures. The membranes of this valves have V shaped grooves extending in the longitudinal direction and the opening angle is chosen in s such a away that the limiting walls of the V shape close against each other presenting a near uniform surface when the membrane is retracted in the median zone by a distribution pressure applied on the exterior. To close a valve of this kind, in a high pressure load situation, one needs a very high distribution pressure. Low or zero pressure is encountered after closing the valve at least in the closed inlets from the pressure side. The high distribution pressure necessary for stopping the flow produces a strong curvature in the membrane in the annular opening facing the inlet. Thus the membrane is very extended by this curvature with respect to its original length. It was noticed that in the presence of this strong longitudinal extension of the membrane, the grooves open again and that a sure closure of the valve is not guaranteed in the presence of high pressure loads.

To avoid these disadvantages, the membrane of this invention is fabricated in such a way that it contains near every supporting neck of the box, a thickening in the form of a circular bead with a first sloped zone that closes the annular opening between the neck and the interior lining like a an annular stopper in the presence of a high pressure against the outside of the membrane with a discharge in the peripheral direction.

When an increasing pressure is applied on the external surface of the membrane in this configuration, the longitudinally sloped zone is applied gradually against the interior lining. If the pressure continues to rise, the non sloped beaded thickening is driven back towards the interior when receiving an initial compression. This circular bead closes the annular opening between the box neck and the interior lining like a circular stopper. Since this part is not sloped, there is no danger of driving the membrane through the annular opening. The discharge that takes place in the peripheral direction, that contributes to an initial compression of the rubber cannot initiate any drag on the surface of the circular bead that is curved in the annular opening which reduces the risk of membrane destruction. During testing membranes configured in the manner described, resisted pressures larger that 100 Kg par cm^2. We noticed, that with this new construction of the membrane, the limit of the pressure of the load is no longer determined by the membrane, but by the box, whereas in the case of the previous art with longitudinal grooves the duty pressure cannot rise above 10 Kg per cm^2 due to the thickness of the walls. In the case of check or inlet valves constructed according to this invention, when the pressure applied to the exterior of the membrane reaches high values, and thus the membrane is extended in the longitudinal direction, the opening obtained from the longitudinal grooves has no effect on the tightness of the valve because the tight

closing is done in the presence of high pressures by the non sloped thickening functioning like a circular stopper of the membrane.

The exterior wall of the membrane is advantageously bulging near the thickening in such a way that there is always an axial curvature in the presence of high pressures. The thickening is present only on the outside of the membrane. Under normal functioning conditions, the circular bead of the membrane is placed by its interior wall outside of the annular section in such a way that in the case of check valves, for opening only the sloped part functioning as a bellow and the thin lip of the membrane applied against the lining get extended. In the case of inlet valves, to close in the presence of a normal or low pressure, only the sloped part placed longitudinally between the thickenings is bulged towards the interior by the distribution pressure until it comes into contact against the interior lining. Only in the case of high pressure loads that it is necessary that the non sloped beaded part is retracted by reducing its diameter. Knowing that a contraction of the beaded part happens only when the part consisting of the longitudinal grooves of the membrane are against the interior lining, there is no danger that the extended bead during the peripheral discharge could fold or flow in different directions. Since the outside thick part has no effect on the flow, the beaded part does not generate any pressure drop inside the conduit to which the valve is attached.

Figure 1 is s longitudinal cross section of a check valve of this invention with the membrane in the resting position

Figure 2 is a half longitudinal cross section of the same valve with valve completely open.

Figure 3 is a half longitudinal cross section of the same valve in the presence of an elevated return pressure.

Figure 4 is a half longitudinal cross section of a check valve in which the membrane shows a different shape.

Figure 5 shows in longitudinal cross section the application of the invention to an inlet valve (i.e Admission valve)

In the check valve of figures 1 to 3, the box is made of an anterior element 1 and a posterior element 2. An interior lining body, aerodynamic or of an oblong shape designed by the number 6 sitting in the element 1 against four ribs 5 uniformly distributed peripherally. The anterior part 7 of the lining body 6 form one whole piece with the ribs 5 and the anterior element 1. The posterior part 8 of the lining body is attached to part 7 by a threaded rod 9 and a nut 10. The box elements 1 and 2 are joined by bolts 11 distributed around the periphery.

The annular opening 13, situated between the box element 1 and the interior lining 6 makes the actual opening of the valve. A membrane in the form of a sleeve designated by the number 14 serves to close opening 13 of the valve. This membrane 14 consists of a tight flange 15 held tightly between elements 1 and 2 of the box , a median part 16 generally conic in shape et a lip 17 formed by the free end of the membrane. The membrane 14 is shown in figure 1 at rest. This state corresponds to shape that the membrane is given during vulcanization. Only the lip 17 shown in figure 1 does not have the shape that it was given during vulcanization. The latter shape, is shown in broken line 17'. During the placement of the membrane in the valve, the lip 17 is a little extended so that it surrounds part 6 with some pressure. The anchored end of the membrane in the box is supported by a shoulder in the form of a neck 21 in the element 1

of the box. The median part 16 of the membrane consists of a thick part 18 extending outward. In addition, to enable a radial extension of the membrane under the pressure of the liquid going through the valve, the median part 16 has around all its periphery alternating internal and external notches having a width of 1millimiter after vulcanization and this corresponds at the shape at rest. The part 16a, adjacent to shoulder 21 of the thick part 10 is not sloped. The axial cross section of the valve shown in figure 1, goes through one of the external notches of the membrane 14. 19 is the bottom of this notch. The depth of the internal notch is indicated by the bottom 20 with a broken line.

Under the action of a liquid passing through the valve, from left to right, the median part 16 of the membrane 14 is extended and takes on the shape shown in figure 2. Since the membrane is made of soft material and that the lip 17 is not very thick , the latter can extend in the valve without any significant pressure drop.

Once the flow stops, the membrane comes back to its original shape shown in figure 1 in which the lip 17 is pushed with a low pressure against the interior lining 6. An increase in pressure with respect to the one on the intake of the valve is translated into a pressure at the exit of the valve. The median part of the membrane is pushed back into the opening of the valve. The shoulder 21 of the element 1 of the box supports the beginning of the median part 16 of the membrane. The thick part 18 stops the median part and the lip from being pushed back through the opening 13 during a high return pressure. Figure 3 shows the shape that the membrane has when the return pressure is very high. In one of the tests, at pressures higher than 100 Kg per cm^2 the membrane has the shape shown in fig 3. In repeated cycles to show the reliability of the construction with maximum return pressures no failure of the membrane was observed. The curvature of the thick part 18 extending outward at rest having the shape shown in figure 1 so that there still a small curvature in the position shown in figure 3. The tests showed that with the new configuration of the membrane the duty pressure is no longer limited by the membrane but by the robustness of the box.

The thick part 18 of the membrane acts like a stop for the annular opening 13. The dimensions of the thick part 18 stops it form being pushed through the opening 13 under the effect of a counter pressure . In addition, the shoulder 21 does not allow the membrane to acquire a deformation inside the opening 13. Finally the grooves 22 formed on the surface of the lining 6 oppose any relative motion between the interior surface of the membrane 14 and the lining 6.

In the shape shown in figure 4, the interior of the membrane shows a shoulder 23 supporting the shoulder 21 of the box in case of high return pressures. This configuration is particularly suited for large nominal widths with a large opening 13.

In the case of the inlet valve shown in figure 5, the valve box consists of the two end pieces 32 and 33 assembled by bolts 34. The body of the interior aerodynamic lining 35 is supported by inside the element 2 of the box by ribs 36 distributed evenly around the periphery. The annular chamber situated between the body of the interior lining 35 and the end pieces of the box 32 and 33 represents the opening of the valve its self that can be closed by the sleeve like membrane 37.

In the upper part of figure 5, the membrane 37 is shown at rest. That is the shape that it takes on when the pressures are equal on all sides. This the shape that the membrane obtains during vulcanization. At both ends, the membrane has radial parts 38 that have peripheral flanges 39. The flanges 39 fit in the corresponding cavities of the

pieces 31 and 32 of the box and serve to anchor the membrane ends. In addition, the ends of the membrane are supported by the shoulders 40 of the box. The middle part of the membrane serves to close the annular opening situated between the body of the lining 6 and the surrounding box. To enable a reduction of the diameter of the middle part 42 of the membrane under the action of a pressurized fluid introduced in the chamber 43 in the back of the membrane, the latter part of the membrane consists of alternating internal and external notches distributed uniformly around the periphery. The axial cross section of figure 5 passes through the middle of an external notch. Line 44 represents the bottom of the external notch whereas the broken line 45 represents the bottom of an internal notch. In the case of a membrane shape undisturbed by external forces, the notches present, in a transverse cross section, walls diverging outward. This divergence is chosen intentionally so that in the case of a retraction of the middle part 42 of the membrane under the effect of a hydraulic pressure introduced in chamber 43 and when the middle part is against the body of the interior lining 35, the walls of the internal and external notches are pressed against each other. When one needs to close the valve, a pressurized fluid is introduced in chambre 43. The applied pressure must be larger than the pressure in the inlet (conduit) so the middle part is pressed against the body of the interior lining 35 thus closing the valve opening. When dealing with systems with high inlet (conduit) pressures, one has to introduce a corresponding high pressure in chamber 43. Known existing valves present the danger that in the case of pressure release in the inlets (conduits), a pressure produced by a secondary source can push the regions near the end of the membrane in the annular opening. This does not happen in this invention because the parts of the membrane enabling the closing of the annular openings consist not only of thick non sloped parts 46 that is chosen dimensionally to act as a stopper in the annular opening.

The thick part 46 is fabricated on the external wall of the membrane and forms a bulge so that the external wall shows a small curvature in axial cross section of this part of the membrane in the presence of the highest pressure as indicated by figure 5. This configuration of the membrane insures that no drag takes place at the surface of the membrane thus reducing its life span. The stopper action of this thick part 46 of the membrane 37 is very well assisted by the shoulder 47 installed on the interior of the membrane in cooperation with the shoulder 40 of the box.

Other modifications can be made by one skilled in the art to the current configuration are considered as part of this invention

Translated by: H. Sahouani.

1,209,471

137-525,13

N° 1.209.475

Société dite :

Vereinigte Armaturen-Gesellschaft m. b. H.

Pl. unique